

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

- Q1
1. (original): An object activity modeling method comprising the steps of:
 - (a) obtaining an optical flow vector from a video sequence;
 - (b) obtaining the probability distribution of the feature vector for a plurality of video frames, using the optical flow vector;
 - (c) modeling states, using the probability distribution of the feature vector; and
 - (d) expressing the activity of the object in the video sequence based on state transition.
 2. (original): The object activity modeling method of claim 1, wherein the step (a) is based on affine motion estimation.
 3. (original): The object activity modeling method of claim 2, wherein the step (a) further comprises the sub-steps of:
 - (a-1) grouping input video frames into a plurality of video frame groups and dividing each video frame group as an individual state;
 - (a-2) obtaining an affine motion parameter for each video in the video frame group of each individual state; and
 - (a-3) obtaining an optical flow vector from the affine motion parameters.

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4. (original): The object activity modeling method of claim 3, wherein the step (a-2) comprises a step for determining parameters, which minimizes summed square difference $\sum (I_t(x) - I_{t-1}(x - V(x)))^2$ over a given video based on the intensity of the pixel on the object, which is expressed as $I_t(x) = I_{t-1}(x - V(x))$ when I denotes intensity, t denotes time, x denotes a pixel location (x, y) , and v denotes the motion vector, as motion parameters.

5. (original): The object activity modeling method of claim 1, wherein the step (b) comprises a step for calculating probability distribution $P(Z|\Omega)$ by the following equation:

$$P(Z|\Omega) = \frac{\exp(-\frac{1}{2}(z - m)^T Q^{-1}(Z - m))}{(2\pi)^N |Q|^{1/2}}$$

wherein $P=(p_1, p_2, \dots p_d)$ denotes a motion vector calculated at each pixel location (x, y) , L denotes the number of pixels in a video frame or a region of interest, d denotes the number of dimensions, feature vector Z , which is a $d \times L$ dimension vector, is $Z = (p_1^1, p_1^2, \dots, p_1^L, p_2^1, p_2^2, \dots, p_2^L, p_d^1, p_d^2, \dots, p_d^L)^T$, m is the mean vector of feature vector Z , and Q is the covariance matrix of feature vector Z , and it is assumed that feature vector Z is provided from observation class Ω .

6. (original): The object activity modeling method of claim 1, wherein the step (b) further comprises the steps of:

decomposing covariance matrix Q as the following equation:

$$Q = \Phi \Lambda \Phi^T$$

Wherein \hat{Z} is equal to Z-m, the columns of Φ are orthonormal eigenvectors of covariance matrix Q, and A corresponds to the diagonal eigenvalue; and calculating probability distribution $P(Z|\Omega)$ by the following equation:

a'

$$P(Z|\Omega) = \left[\frac{\exp(-\frac{1}{2} \sum_i^M y_i^2 / \alpha_i)}{(2\pi)^M |\Lambda|^{1/2}} \right] \left[\frac{\exp(-\frac{1}{2} \sum_{M+1}^N y_i^2 / 2\rho)}{(2\pi\rho)^{(N-M)/2}} \right]$$

wherein M is the number of principal components, y_i is the i-th component of Y, α_i is the i-th eigenvalue of Q, and ρ is the optimal value, which is obtained by $\rho = \frac{1}{N-M} \sum_{M+1}^N \alpha_i$, and it is assumed that feature vector Z is provided from observation class Ω .

7. (original): The object activity modeling method of claim 1, wherein in the step (c), the object activity in the video sequence is expressed using a Hidden Markov Model (HMM), based on state transition.

8. (original): The object activity modeling method of claim 7, wherein the Hidden Markov Model (HMM) is expressed as $\lambda = \{\Xi, A, B, \Pi\}$ when N is the number of possible states, Ξ satisfies $\Xi = \{q_1, q_2, \dots, q_N\}$, A is $\{a_{ij}\}$, the transition between hidden states i and j, B is $\{b_j(\cdot)\}$,

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the observation symbol probability corresponding to state j , and Π is the initial state distribution, and the state $\Xi = \{q_1, q_2, \dots, q_N\}$ and the initial state distribution Π are determined in advance based on video data.

9. (original): An object activity recognition method comprising the steps of:

(a) obtaining feature vectors by motion estimation for video frames;

(b) determining a state, to which each frame belongs, using the obtained feature vectors;

and

(c) determining an activity model, which maximizes the probability between activity models and a video frame provided from a given activity model dictionary using a transition matrix for the determined state, as the recognized activity.

10. (currently amended): The object activity recognition method of claim 9, wherein

the step ~~(d)~~ (c) comprises a step of finding an activity model, which maximizes probability

$P(O|\lambda)$ from the given activity model dictionary $\{\lambda_1, \lambda_2, \dots, \lambda_E\}$, when T is a positive integer

indicating the number of frames forming the video sequence, Z_1, Z_2, \dots, Z_T are feature vectors of

first frame, second frame, ..., T -th frame, respectively, and if video frame $O = \{Z_1, Z_2, \dots, Z_T\}$ is

given and E is the number of state models.

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Q' 11. (original): The object activity recognition method of claim 10, wherein the transition matrix is obtained by using an expectation-maximization (EM) algorithm based on the observation symbol probability $\{b_j(\cdot)\}$ corresponding to scene j in the training process.
